Title IIB Massachusetts Math and Science Partnership
Project Evaluation Report of Findings

Name of Partnership	**Collaborating to Create a Science Learning Community**
Reporting Period	**September 2010-August 2011**
Date of Report Submission	**10/5/11**

Individuals Contributing to the Completion of This Report			
Name	Partnership Role	E-mail Address	Phone Number
Molly Laden	Project Coordinator	mladen@tritec-inc.org	617-381-7426
Diane Schilder	External Evaluator	dschilder@eval-inc.com	617-816-2026

Courses Offered: September 2008-August 2011	
Course Name	**Course Focus** *(“Math” or “Science/Technology” or “Blended Math and Science/Technology”)*
Physics: Electricity and Magnetism	Science/technology
Biology: Cell Biology and Genetics	Science/technology

Description of Supplemental Activity and Dates	**Course Name(s) or School or District Initiative(s) to Which Supplemental Activity Was Related and Funding Period of Course(s)**
32 hours of supplemental activities designed to assist participating teachers in creating classroom lessons incorporating the *Physics: Electricity and Magnetism* content and inquiry-based learning experiences for students. Eight hours were held before and during the course, additional 24 hours of online and face-to-face workshops occurred after the course was completed. **Summer 2011**	Physics: Electricity and Magnetism **Winter/Spring 2011**
32 hours of supplemental activities designed to assist participating teachers in creating classroom lessons incorporating the *Biology: Cell Biology and Genetics* content and inquiry-based learning experiences for students. Eight hours were held before and during the course, additional 24 hours of online and face-to-face workshops occurred after the course was completed. **Summer 2011**	Biology: Cell Biology and Genetics **Summer 2011**

* “supplemental activities” are also referred to as “follow-up activities.”

I. Introduction

Partnership Name:	*Collaborating to Create a Science Learning Community*			
Partners: School Districts (5) Everett Public Schools (Lead Applicant) Chelsea Public Schools Malden Public Schools Medford Public Schools Wilmington Public Schools Private Schools (4) Malden Catholic High School Cheverus Centennial School Saint Clement High School Pope John XXIII High School	Other LEAs Mystic Valley Regional Charter School (MVRCS)	Collaborative (1) Tri-City Technology Education Collaborative (TRITEC)	Higher Education (1) University of Massachusetts Boston, Center for Science and Math in Context (COSMIC) University of Massachusetts Boston, School of Education	Project Evaluator (1) Dr. Diane Schilder, Evaluation Analysis, Solutions, Inc. (EAS, Inc.)
Course Locations:	*Physics: Electricity and Magnetism* Medford High School, Medford, MA		*Biology: Cell Biology and Genetics* University of Massachusetts Boston	
Course Formats:	*Physics: Electricity and Magnetism* Medford High School, Medford, MA 60 hours classroom and lab coursework conducted afterschool and Saturdays + 32 hours of supplemental activities conducted face-to-face and online		*Biology: Cell Biology and Genetics* University of Massachusetts Boston 60 hours classroom and lab coursework summer institute format + 32 hours of supplemental activities conducted face-to-face and online	
Beginning and End Course Dates: **Supplemental Activities Dates:**	*Physics: Electricity and Magnetism*	January 25 - May 24, 2011 June - August, 2011	*Biology: Cell Biology and Genetics*	July 5 - 15, 2011 July - August, 2011
Number of Participants:	*Physics: Electricity and Magnetism*	18 participants	*Biology: Cell Biology and Genetics*	25 participants

II. Goals and Objectives

The design of the *Collaborating to Create a Science Learning Community* project is based on a successful model that TRITEC has utilized in a variety of projects. In this model, teachers come together across neighboring similar-size districts to participate in university-led, content-driven, professional development in *theory* that teachers then put into *practice* in their respective districts through facilitated activities orchestrated by the Teacher Learning Center Directors (TLCDs). To assist teachers in translating science content and inquiry-based teaching into effective lessons for students, the TLCDs serve as mentor teacher leaders and work closely with district curriculum leaders and university faculty. This allows for customizing the content and aligning it with local district curricula and needs. The TLCDs serve as glue for the project's components, ensuring that (1) university faculty sessions meet teacher needs, (2) appropriate focus is placed on the inquiry-based teaching skills of teachers, and (3) the teachers understand how to integrate the science content into their district curriculum as evidenced through effective lesson development.

The offering of graduate science courses to multiple grade-level teachers encourages vertical curriculum alignment in this content area for the entire K-12 system, so that working in a community of learners, teachers can consider the knowledge, tools, skills, teaching practices, and assessment used to measure student learning in the grade levels *before and after* their own classrooms. For example, a teacher in 5th grade may learn from their colleagues exactly what students must know and be able to do by the time they reach 8th grade. The 8th grade teacher may begin to understand what students in 5th grade were taught and what resources and teaching methods were used. Vertically-aligned curriculum understanding can improve the science learning outcomes for students in all grades.

The project intends to change the manner in which teachers approach science subjects, bringing 21st century learning strategies into the classroom. Activities are designed to increase student science knowledge by ensuring that participating teachers acquire deep science content knowledge as demonstrated through the development of sound inquiry-based lessons. Teachers learn how to develop and implement problem-based activities that engage their students so that they better understand the science content. These lessons require students to use analytical and investigation skills to demonstrate their understanding of key concepts.

The project's objectives are aligned to the following MMSP program goals: (1) develop and implement an effective and sustained course of study for multi-district in-service teachers of science, technology/engineering and mathematics (STEM) by integrating the courses of study into the UMASS Boston COSMIC center that includes the colleges of science and math and the college of education; (2) increase the number of science teachers in the collaborating schools who are licensed in the subject area(s) and grade level(s) they teach; (3) increase the number of STEM teachers in the collaborating schools who participate in high quality professional development and advance their content knowledge; and (4) develop and implement a systemic approach to STEM education by integrating professional development with district and school improvement initiatives.

Key Evaluation Questions

The formative evaluation questions focus on the nature, quality and outputs of the project.

1) What is the nature and quality of the key components of the TRITEC intervention?
2) Each year, does the project meet its goals in terms of the number of participating teachers and the number of courses taken? Over the course of the project, how many teachers obtain licensure?

The summative evaluation questions (3 and 4) that will be addressed over the course of the evaluation are:

3) Do teachers who participate over multiple years demonstrate greater benefits in terms of pedagogy and content knowledge than teachers who participate in a single year?
4) What is the impact of the project? What are the most important components of the intervention that leaders and participants believe led to desired outcomes? What is the impact of the project on participating teachers? Specifically, how did the project change participant teachers' science content knowledge and pedagogical approaches? What is the impact of the project on students of participating teachers?

The project Leadership Team articulated project benchmarks or criteria against which progress was assessed and informed each evaluation question. Draft benchmarks were presented in the proposal and were refined by the Leadership Team during the first few months of the project. The refined year-one benchmarks are presented in the chart below.

Chart 1. Collaborating to Create a Science Learning Community

Evaluation Questions and Associated Benchmarks

Evaluation Question	Benchmark
What is the nature and quality of supports offered by partner districts?	• At least 4 meetings will occur each year with participation across all partners • At least 70% of teachers will report that the courses are high quality as measured by post-course surveys • At least 70% of teachers will report increases in confidence attributed to the courses
How many teachers obtained licensure over the course of the project?	• The project will lead to increases in licensure among participants by the end of the project
What percentage of teachers who enrolled in the courses completed each course?	• At least 75% of teachers registered in courses will complete all course requirements
What percentage of teachers significantly increased their content knowledge in science?	• At least 70% of teachers will significantly increase content knowledge
What percentage of teachers reported improvements in science content knowledge?	• At least 70% of teachers who complete courses will report improvements in their students' science content knowledge
What is the impact of the project on participating teachers?	• Teachers completing course will report impact on content knowledge and inquiry-based teaching practices
What is the impact of the project on students of participating teachers?	• Annually a sample of students (n=60) of participating teachers completing project courses will demonstrate significant content gains when compared with non-participating teachers' students.*

*Focus of year 2 evaluation. Limited data provided in year 1.

III. Recruitment

Planning meetings identified a variety of areas of science content needs based on changing district curricula, MCAS performance analysis and existing teacher skills and experience. Teachers were surveyed to determine preferred content and format for delivery of the courses. District administrators and curriculum leadership discussed and identified the specific science professional needs of their teachers to ensure that the course offerings met the needs identified by both the teachers and their administrators. All of this information was incorporated into the project design.

For the partnering school districts and schools, all teachers who teach science grades 5-9 (including special education and ELL) were recruited. Targeted recruitment included: (1) ensuring that teacher applications were widely circulated, since all grant work occurs during the summer or on an afterschool basis, with participating teachers each receiving three graduate credits per course (all teachers were also eligible to receive a stipend for completing the 32 hours of supplemental activities); (2) holding district informational sessions conducted by the Teacher Learning Center Directors and curriculum directors, highlighting the integration of content and

state learning standards embedded within teacher-created project lessons; (3) working with central administration and targeted school principals to offer incentives for teacher project participation to include, but not limited to, extensive in-service credits, and the application of graduate credits earned towards other graduate programs in which teachers are enrolled, and/or for district salary increases; and (4) working with school principals to uncover teacher incentives for project participation that may have been pertinent to a particular school only (i.e. some schools are looking towards creating upper elementary math/science specialist positions).

Once teachers were recruited according to the plans outlined above, those teachers worked closely with each district's science curriculum director to ensure that lesson development addressed stated MCAS and other school benchmark science deficiencies.

Recruitment was a topic discussed in the project's spring 2011 Advisory Board/Leadership Team meeting. Due to unanticipated difficulties recruiting teachers from the partnership schools for the Physics course offered in the 2011 winter/spring, the project worked collaboratively with the Boston Science Partnership initiative to recruit participants for the Biology course offered during the 2011 summer. The Physics course had 18 teacher participants (goal 25), 17 of the 18 were from *Collaborating to Create a Science Learning Community* project partnership districts/schools. A total of 89% of these teachers were from high-need schools/districts. The Biology course had 25 teacher participants (goal 25), and 11 of the 25 teachers were from *Collaborating to Create a Science Learning Community* project partnership districts/schools. Sixty-seven percent of these teachers were from high-need schools/districts. It is important to note that only 20 percent of participants reported taking the courses to assist with licensure. The project leaders are using this data to re-evaluate the benchmark of increasing licensure since the majority of participants are taking the courses in order to gain graduate credit, rather than to obtain licensure.

IV. Formative Evaluation

A. Methods. TRITEC hired an external evaluation team from EAS, Inc.

1. *Participants* in the evaluation are listed in the table below.

2. *Design*. The evaluation team employed a mixed-methods participatory evaluation strategy designed to obtain, analyze and report formative evaluation data. The evaluation team obtained data about the nature and quality of project activities to guide decision-making for future activities.

Instruments/Protocols. The external evaluation team developed surveys, observation protocols, and semi-structured interview protocols to collect formative evaluation data. The instruments and protocols are described in the table below. The evaluators developed: a) semi-structured interview protocols to collect data from participating teachers; b) observational protocols; c) Pre and Post Professional Development Surveys designed using items from established validated surveys including the International Society for Technology in Education (ISTE) National Technology Education Standards (NETS) items and questions used by other Mathematics and Science Partnership projects. These surveys were designed to capture baseline attitudes, knowledge and practices related to the University of Massachusetts Boston (UMB) science courses (focused on content and pedagogical approaches) and related to the follow up workshops (focused on teaching science using Web 2.0); and d) document review protocols. In addition, the evaluation team used the Reformed Teaching Observation Protocol (RTOP) to collect observational data. The Reformed Teaching Observation Protocol (RTOP) was created by the

Evaluation Facilitation Group (EFG) of the Arizona Collaborative for Excellence in the Preparation of Teachers (ACEPT). It is an observational instrument designed to measure "reformed" teaching. This tool, developed with support from the National Science Foundation is designed to capture key elements of reformed teaching as articulated in the National Research Council, 1996 report on science teaching and learning. Specifically, it captures the degree to which a teacher supports inquiries while interacting with students, orchestrates discourse among students about scientific ideas, challenges students to accept and share responsibility for their own learning, recognizes and responds to student diversity and encourages all students to participate fully in science learning, and encourages and models the skills of scientific inquiry as well as curiosity and openness to new ideas.

3. *Data Collection Procedures.* The evaluation team is comprised of researchers trained in valid and reliable data collection, analysis, and reporting. All data was collected employing procedures that ensure reliability. To collect data related to the quality of partner supports, the evaluation team participated in project activities and events and collected data using observation and interview protocols. These data were collected using a running record and were subsequently coded. To obtain data about the participants' perceptions of the quality of supports, surveys were administered using SurveyMonkey and follow up emails were sent to non-respondents. These surveys were sent to all participants prior to their participation in the professional development (before the courses began) and again after the professional development (after the course and supplemental activities were completed). The evaluation team used protocols to clean and code secondary data that were included in the evaluation report and internal reliability checks were conducted. Finally, document review protocols were used to analyze existing data.

Data Collection Activities

Data collection instrument/ Procedure	Description	Participants (Number)
Observations, informal interviews, and semi-structured interviews	Project Team meetings (in person participation) Informal conversations with Leadership Team members Semi-structured interviews with teachers Observations of participating teachers' classrooms using the Reformed Teaching Observation Protocol Observation of call back	12 Various 6 4 2 events (24 Biology participants and 18 Physics participants)
Surveys	Pre and Post Professional Development Surveys: • Matched comparison group Post only	32* 43
Document Review	Project communications Course materials+ Course attendance and completion data+ Artifacts from courses and from teachers including postings to the Wiki; final lessons TRITEC documentation	Various

* A total of 42 pre and 43 post surveys were completed. However, 11 surveys did not include unique identifiers and were not included in the analysis because we were unable to match pre and post records. The evaluator will require all participants to report unique identifiers in all surveys in year 2.
+ Data collected by TRITEC/collaborating districts, UMB faculty, and/or entered/reported by UMass Donahue Institute.

Evaluators used varied qualitative and quantitative methods to examine and describe project activities and associated impacts on teachers and their students. The quantitative data analysis included simple descriptive statistical analyses of survey data and course pre and post-assessment data. In addition, the evaluators performed inferential statistical analyses to determine whether changes in teacher content knowledge were statistically significant. Additional quantitative data collection and analysis will be completed in subsequent years. Our qualitative methods were guided by Miles & Huberman's framework of creating an initial coding schema, refining the codes after preliminary analysis, and exploring emerging themes and trends (Miles, M. & Huberman, A., 1994). Qualitative data were coded based on a schema that examined the relationship between actors (such as Leadership Team members and teachers), activities (such as the regular project meetings and the science courses), outputs (such as teacher attendance rates and their final course products), and outcomes (changes in participating teachers perceptions of their knowledge of science content and their ability to teach science).

B. Formative Findings

1. *Response rates.* A total of 32 teachers completed the matched Pre and Post Professional Development surveys. This represents 76% of all participants who completed the courses. All 43 teachers (100%) completed anonymous Post-Professional Development surveys but 11 individuals did not include unique identifiers so these surveys were not included in the matched comparison analysis. A total of four teachers volunteered for observations and five teachers participated in semi-structured interviews.

2. *Findings.* During the past year the project, with support from the Leadership Team, successfully completed all planned activities. These activities were:

- Implemented the planned professional development (the University of Massachusetts contextualized curriculum courses and the supplemental opportunities which consisted of a series of 8 workshops on inquiry-based learning and Web 2.0 skills in the science classroom); the development and implementation of these activities leveraged lessons learned from previous and from other MSP projects
- Recruited a total of 40 unique individual teachers (with 3 teachers taking both courses) who completed graduate-level science courses
- Ensured teachers represented a broad range of grades and taught in classrooms in which children reflected a broad range of socioeconomic backgrounds by targeting teachers from the collaborating school districts (67.5% of participants were from high-needs districts)
- Refined the curriculum as well as the format of the courses to reflect the unique needs and background characteristics of participating teachers
- Successfully met the benchmark of ensuring that at least 75% of recruited teachers completed the graduate coursework

- Provided teachers with an opportunity to share perspectives regarding the development of lessons and learn from teachers who had implemented the lessons about their experiences
- Used formative data to revise activities with the aim of meeting the needs of participants, and their schools

In addition, the project met nearly all planned benchmarks related to project activities. It is important to note that the participants taught a total of 396 mathematics students and 3325 science students. The sole exception to meeting project benchmarks in year 1 was that the enrollment in the professional development was lower than anticipated—with enrollment of 43 instead of the target of 50. The Leadership Team met to discuss ways to ensure future year's enrollment and developed strategies to engage curriculum directors and teachers earlier in the recruitment process to reach enrollment targets in future years.

During the first year of the project, per the original design, a total of 2 University of Massachusetts, Boston graduate courses were offered to teachers in the collaborating districts:

1) Physics: Electricity and Magnetism
2) Biology: Cell Biology and Genetics

The project successfully met the benchmark of ensuring that at least 75% of the recruited teachers completed the courses. In fact, all 43 individuals who began the courses in earnest completed the Physics and Biology courses.[1] Moreover, 41 of the 43 individuals completed all aspects of the professional development—a completion rate of over 95%.

Reports from the Leadership Team and interviews with instructors reveal that the faculty teaching these courses used lessons learned from the Boston Science Partnership and from previous MSP courses to inform pedagogical approaches, content and format of the courses. Project leaders collaborated with other MSP projects to inform recruitment strategies. Each course used pre-test and regular assessment data to offer differentiated instruction targeted to the baseline content knowledge and abilities of the participating teachers. In addition, each course was designed to address the Massachusetts curriculum frameworks.

Per the original design the physics course was co-taught by university faculty and two classroom teachers. The Physics course was co-taught by a university faculty member and two K-12 teachers from the partner districts. The Biology course was co-taught by a university faculty member and two K-12 teachers from the Boston Public Schools. District partners reported that by including teachers from the collaborating districts, the project tailored the content to meet the needs of the target districts and built in local mentors and teacher leaders.

Participants Provided Positive Reports about the Professional Development

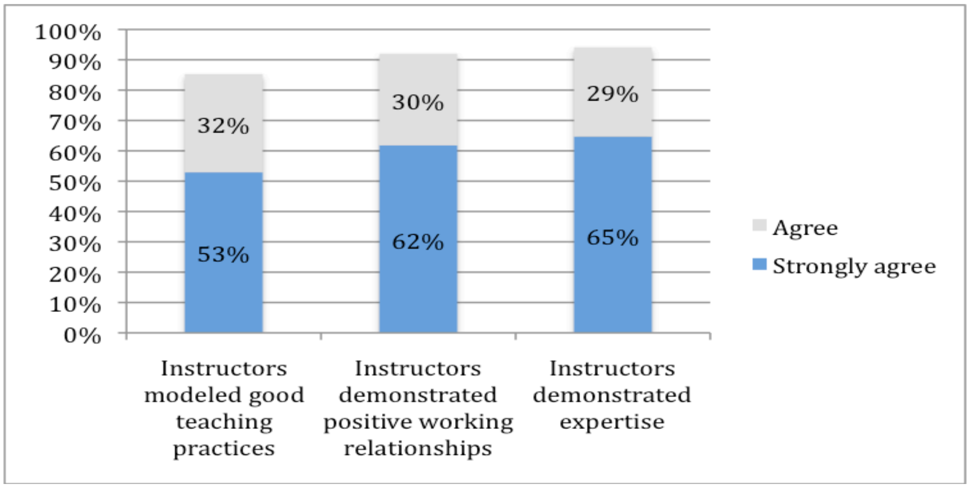
The project successfully met the benchmark that at least 70% of completers would provide favorable reports about the professional development activities. Participating teachers completed Post Surveys that included questions about the quality of the professional development.

The three graphics below illustrate participants' perspectives of the professional development. Participants in the Biology and Physics courses and follow-up supplemental activities provided favorable ratings regarding the instructors, the structure, and the way in which the experience contributed to their development of a learning community. As illustrated in Graphic 1 below,

[1] Three additional teachers expressed initial interest in the Physics course decided not to enroll after obtaining information about the course requirements.

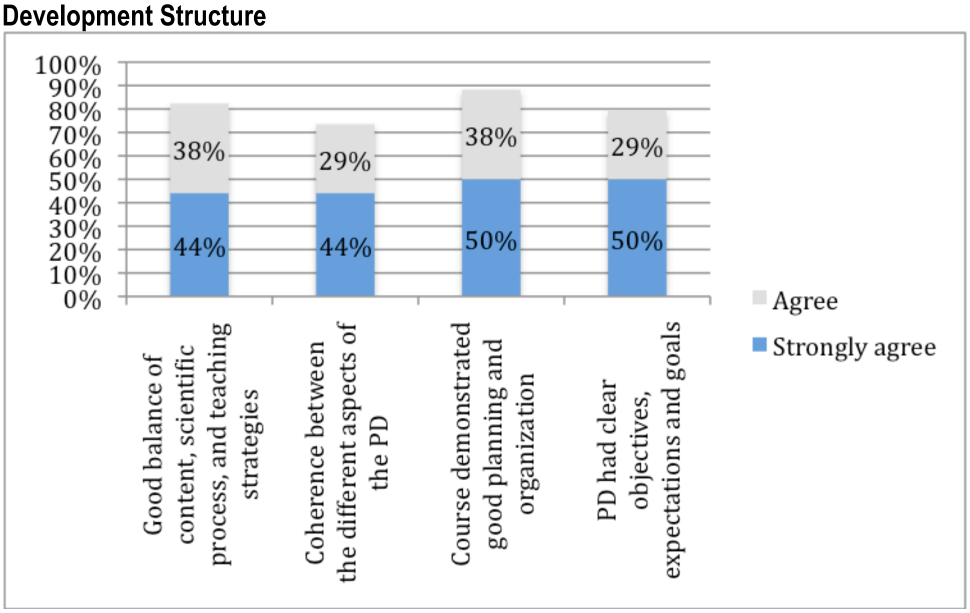
over 90% of participants reported that the course instructors demonstrated a positive working relationship and demonstrated expertise, and over 80% reported that the instructors modeled good teaching practice.

Graphic 1. Percent of Participants Who Agree or Strongly Agree with Statements Regarding Instructors



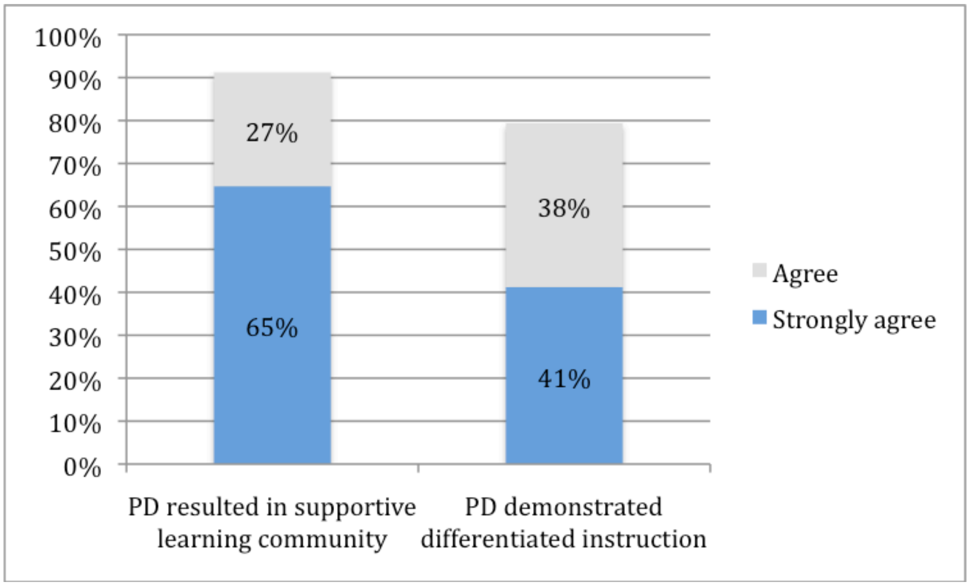
Participants provided favorable reports about the structure of the professional development (this includes the content courses and the follow up supplemental activities). Over 70% of participants either agreed or strongly agreed that the professional development offered a good balance of content and strategies, coherence among the aspects, and that the professional development demonstrated planning and had clear objectives. See Graphic 2 below.

Graphic 2. Percent of Participants Who Agree or Strongly Agree with Statements Regarding Professional Development Structure



Participants also reported that the professional development supported a positive learning community and demonstrated differentiated instruction.

Graphic 3. Percent of Participants Who Agree or Strongly Agree with Statements Regarding the Professional Development



Participants were also asked for suggestions to inform the refinement of future professional development activities. Teachers who participated in both the Biology and Physics courses and the supplementary activities liked the formats, even though the Physics course was offered during the school year at Medford High School, and the Biology course was offered during two weeks in the summer at the University of Massachusetts Boston. Some of the elementary school teachers reported that they "struggled" with the science content but felt they learned important principles and concepts.

A number of teachers also stated that they wanted additional opportunities to exchange ideas and lessons among participants. For example, one teacher reported:

> [I suggest] allowing time for teachers to share and relate their own classroom experiences to what is presented in class. This could take place in whole class discussion or by working in grade level groups.

These participants had completed the Post-Professional Development Survey prior to the scheduled call-back meeting. The scheduled call-back meeting focused on teacher lesson development sharing, allowing teachers to come together and share the results of their lesson development and implementation. Lessons learned and promising practices were identified.

C. Usage

During Year 1, the project successfully completed all planned activities and met all benchmarks except the recruitment target. The Leadership Team used formative data to refine activities. The evaluator participated in regular meetings with key leaders to share lessons learned and early insights. Leadership Team members reflected on the professional development structure and location, and plan to use the data collected to inform future activities. Some teachers reported that they wanted additional opportunities to share information, but the project had already planned these activities and provided teachers with opportunities to continue to collaborate

online through ongoing support of individual teachers' wikis. The evaluation team also gathered formative data related to the supplementary activities and this information and the usage is presented in section VIII.

V. Impact on Teacher Content Knowledge

A. Methods

1. *Participants.* All 43 teachers who participated in the project activities participated in the impact evaluation. All 43 teachers completed Post Teacher Content Knowledge Assessments. A total of 16 of the 18 participants (88%) in the Physics course completed Pre and Post Professional Development Surveys and 100% of the 25 participants in the Biology course completed Pre and Post Professional Development Surveys. A total of 32 matched surveys were collected and analyzed (13 from Physics and 19 from Biology participants). The remaining teachers surveyed did not include identifying information and thus were not able to be matched. In addition, observation data were collected from 4 teachers, 6 teachers were interviewed, and lessons developed by 41 participating teachers were reviewed.

2. *Design*. The external evaluation team conducted a criteria-based evaluation strategy (Wilson & Onwuegbuzie, 1999). As such, the evaluators analyzed the impact data against the desired benchmarks established by the Leadership Team.

Instruments/Protocols. The external evaluation team developed surveys, observation protocols, and semi-structured interview protocols to collect formative evaluation data. The instruments and protocols are described in the table below. The evaluators used the following instruments/protocols to collect data.

a) A semi-structured interview protocol to collect data from participating teachers. This protocol consisted of 12 questions designed to capture attitudes, knowledge and practices regarding science teaching and student learning.

b) Observational protocols including a running record and the Reformed Teaching Observation Protocol (RTOP). The Reformed Teaching Observation Protocol (RTOP) was created by the Evaluation Facilitation Group (EFG) of the Arizona Collaborative for Excellence in the Preparation of Teachers (ACEPT). It is an observational instrument designed to measure "reformed" teaching. This tool, developed with support from the National Science Foundation is designed to capture key elements of reformed teaching as articulated in the National Research Council, 1996 report on science teaching and learning. Specifically, it captures the degree to which a teacher supports inquiries while interacting with students, orchestrates discourse among students about scientific ideas, challenges students to accept and share responsibility for their own learning, recognizes and responds to student diversity and encourages all students to participate fully in science learning, and encourages and models the skills of scientific inquiry as well as curiosity and openness to new ideas.

c) Pre and Post Professional Development Surveys—designed to capture baseline attitudes, knowledge and practices related to the University of Massachusetts Boston science content courses (focused on content and pedagogical approaches) and related to the supplemental activities (focused on teaching science using Web 2.0 technologies). The Pre Professional Development Survey included a set of questions about technology confidence and use, a set of questions about current pedagogical practices, and a set of questions about

confidence employing a range of pedagogical practices specific to science teaching. The Post Professional Development Survey included the same set of questions on the Pre Survey but also asked participants about perceived impact of the professional development

d) Document review protocols-- including a set of protocols to guide the review of lessons developed by participants. The evaluation team performed secondary analysis of Biology Teacher Content Knowledge Assessment data as well as Physics Teacher Content Knowledge Assessment data that were collected by University of Massachusetts Boston(UMB) faculty prior to and after completion of each science content course. The UMB faculty developed these instruments. The Physics assessment was a 20-item assessment administered to participants prior to taking the Physics course and at the end of the Physics Course. The Biology Assessment was a 70-item assessment administered to participants prior to taking the Biology course and at the end of the Biology Course. (Sample Teacher Content Knowledge Assessments are presented in the Appendix). No analyses were performed to assess the validity or reliability of the university faculty-created assessment instruments.

3. *Data Collection Procedures.* The evaluation team collected Pre and Post Professional Development Survey data using SurveyMonkey. The team used the document review protocols to review teacher lessons posted to the project's Wiki spaces pages, and a sample of lessons from teachers who volunteered to provide samples of lessons that had been implemented prior to participation in the project (baseline).

Chart 2. Data Collection Activities

Data collection instrument/ procedure	Description	Participants (Number)
Observations and semi-structured interviews	Informal teacher interviews Reformed Teaching Observation Protocol observations Observation of call back	6 4 2 events (24 Biology participants and 18 Physics participants)
Surveys	Pre and Post Professional Development Surveys (matched comparison group)	32
Secondary data	Background survey data* Teacher Content Knowledge Assessment data *	40 41
Document Review	Artifacts from courses and from teachers including postings to the Wiki; final projects	Various

* Assessments administered by the project and entered/reported by UMass Donahue Institute

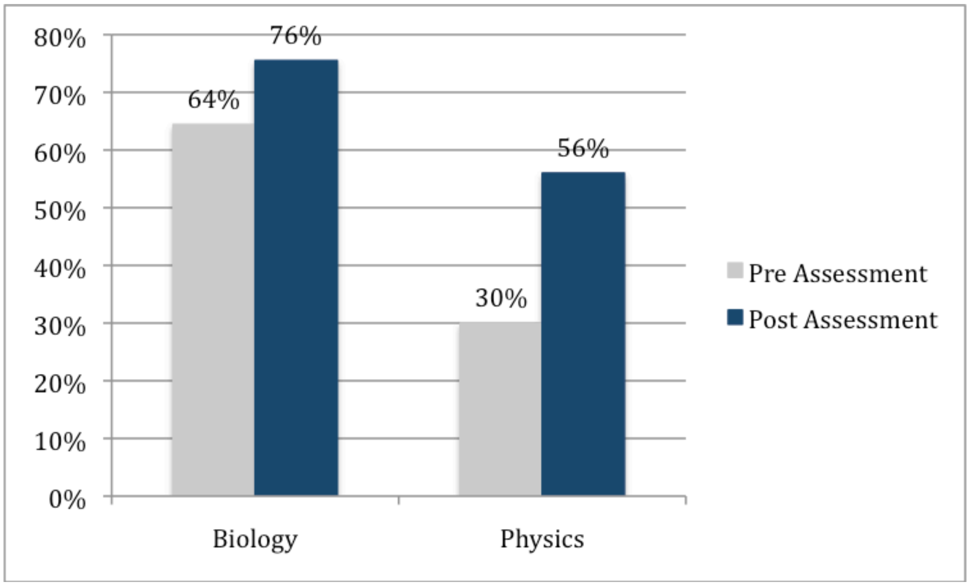
B. **Results**

1. *Response rates.* All 43 teachers completed Post Content Knowledge Assessments but two teachers did not complete the Pre–Assessment. Thus 93% of participating teachers had matched content assessment data. A total of 32 teachers completed the matched Pre-and Post-Professional Development surveys (13 from Physics and 19 from Biology participants). This represents 76% of all participants who completed the courses. While 100% of the 43 teachers who completed the course completed anonymous Post Professional Development Surveys, 11 individuals did not include unique identifiers so these surveys were not included in the matched comparison analysis. In addition, a total of four teachers volunteered for observations and six teachers participated in semi-structured interviews.

2. *Findings.* Ninety-four percent of year 1 participants in the Physics course demonstrated statistically significant content gains and 72% of year 1 participants in the Biology course demonstrated statistically significant content gains. The Leadership Team expressed interest in comparing the outcome scores of participants in the Physics and Biology courses to inform future programming. When presented with the results, the Leadership Team asked why a higher percentage of Physics participants than Biology participants demonstrated statistically significant gains. To address this question, the evaluator analyzed the post scores of the group of Biology teachers who did not demonstrate significant gains and found that their average score on the pre assessment was 87% correct and the average score on the post assessment was 92% correct. This analysis supports the theory that the reason the sub-set of participants did not demonstrate significant knowledge gains was a result of "ceiling effect." In other words, these students had less room to increase than the students who had lower pre assessment scores.

The overall gains in content knowledge for both groups were quite high. As Graphic 4 below shows, teachers participating in the Biology course demonstrated a 12% point gain and teachers participating in the Physics course demonstrated a 26% point gain. Independent samples t-test analyses revealed that the gains for the Biology teachers were statistically significant ($p<.01$), and the gains for the Physics teachers were very significant ($p<.001$).

Graphic 4. Teacher Participants' Pre and Post Content Knowledge Assessments (Percent Correct, Range 0-100)



Teachers also reported in their own words that the professional development led to increases in content knowledge. Teachers in the Physics class reported they learned about the six different types of energy (chemical, electrical, thermal, radiant, mechanical and nuclear), gained an understanding of force as a push or pull, learned about magnetism and electromagnetism, waves (e.g., velocity, frequency, wavelength, amplitude, period as well as examples of simple harmonic motion). Participants in the Biology course reported learning about cells and genetics at a deeper level, reported feeling challenged by learning the latest in the field of biology, and reported learning about protein synthesis, parts of a cell, genetics, and replication. Examples of teacher reports of content learning are presented below:

> My understanding of cell biology and genetics has greatly improved as a result of the class lectures and many hands-on activities. [7th grade teacher]

> I've learned so much in this course. My personal content knowledge about waves and electricity has increased. I now feel comfortable delving into side topics of electricity when we discuss energy in my classroom. [7th grade teacher]

> Presentation of the physics content in class helped confirm to me that I was knowledgeable in the areas in which I instruct my students (light & sound) and it broadened my background / understanding in an area that I don't teach (electricity). [5th grade teacher]

> As I sat through the class and experienced the Active Physics model of instruction, a thought that frequently came to mind was the amount of angst & struggling many high school students experience when taking physics classes and the strong dislike for / self defeating attitude toward the subject that often develops. Use of this model made the topics interesting, easy to understand, and took away the stigma attached to the word physics. I wonder how many high school physics teachers have been given the opportunity by their departments to use this type of model in their teaching? It would probably help make it easier for them to motivate their students if they could do so. [Anonymous]

C. Discussion

A primary aim of the project in Year 1 was to provide professional development to teachers to increase their science content knowledge. To achieve significant gains in content knowledge, the research literature suggests that professional development must be of sufficient quality, depth, and duration. Reviews of research on professional development reveal that many early professional development innovations show mixed or limited outcomes regarding gains in teacher content knowledge (Fishman, Marx, Best, & Tak, 2003). It is therefore notable that the project achieved the goal of increasing participating teachers' content knowledge in its first year. For teachers participating in the Physics and Biology courses, the content gains were statistically significant *($p<.01$).* The number of individuals who gained significant content knowledge in Physics was higher than the number who gained significant content knowledge in Biology. Yet across both groups, teachers reported that the content gains gave them more confidence in teaching science content and in tailoring the content to their students.

VI. Impact on Teacher Classroom Practice

A. Methods

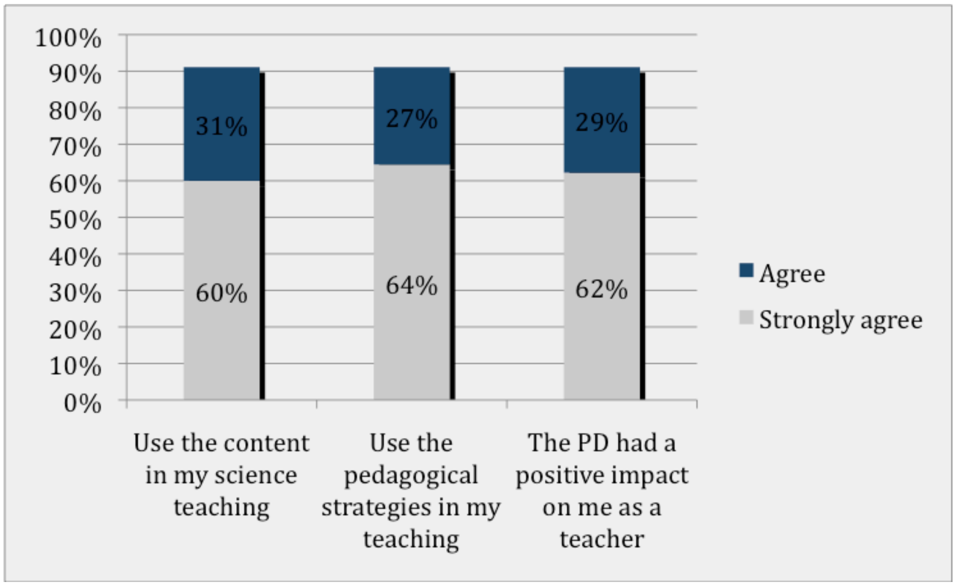
The methods to assess impact on classroom teaching practice are described in Section V above.

B. Results

1. *Response Rate.* A total of 32 teachers completed the matched Pre and Post Professional Development Survey. This represents 76% of all participants. While 100% of the 43 teachers who completed the course completed anonymous Post Professional Development Survey, 11 individuals did not include unique identifiers so these surveys were not included in the matched comparison analysis. In addition, a total of four teachers volunteered for observations and six teachers participated in semi-structured interviews.

2. *Findings.* Participants were asked questions about whether the course has had an impact to date and whether they believed it would have an impact in the future. Participants reported that the professional development has had an impact on their classroom practice and reported that they believe it will continue to into the future. Graphic 5 (below) demonstrates that over 90 % of those who participated in the professional development course and activities, who completed Post Professional Development Surveys reported that they planned to use the content from the courses in their teaching. It also shows that over 90% reported that they planned to use the pedagogical strategies they had learned. Moreover, 91% of participants reported that the professional development has already had a positive impact on them as teachers.

Graphic 5. Post Professional Development Survey Results: Percent of Participants Who Agreed or Strongly Agreed with Statements About the Impact of the Professional Development

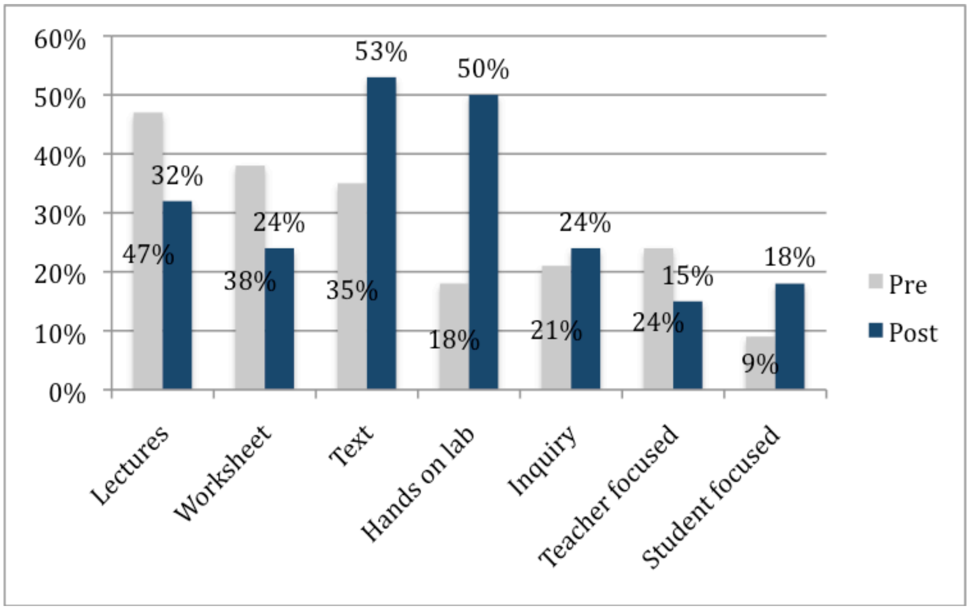


Analysis of matched pre and post survey data revealed significant changes in self-reported classroom teaching practice by teachers who had taken the Biology and Physics classes.

Teachers reported feeling more confident teaching science using a range of pedagogical strategies and approaches. Teachers reported increases in confidence lecturing, teaching from a text book and teaching using workshops. When asked about this increase in confidence, teachers reported that they had additional content knowledge and felt that they had a better understanding of when it was appropriate to use particular strategies. Moreover, a large percentage of teachers reported that they moved from feeling not very confident to feeling confident teaching using inquiry based approaches and hands on labs—approaches that they employed infrequently prior to their participation in the project.

Teachers also reported that the pedagogical approaches they employed changed as a result of participation in the project. Specifically, teachers reported (both in qualitative interviews and in a comparison of Pre and Post Professional Development Surveys) that they engage in more student-focused, hands on labs, and inquiry-based activities after participating in the project. Moreover, teachers reported decreases in the use of lectures and worksheets. Teachers were asked about frequency of engaging in different pedagogical approaches. The graphic below presents the percentage of teachers who reported engaging in various approaches 5 times a week or more. This graphic shows that on the pre-participation survey, 47% of teachers reported lecturing 5 or more times a week but only 32% reported lecturing 5 or more times a week on the post-participation survey. In contract, only 18% of participants reported using hands-on labs 5 or more times a week on the Pre Professional Development Survey and 50% reported using this pedagogical approach on the Post Professional Development Survey.

Graphic 6. Participants' Pre and Post Professional Development Survey Results: Percent Engaging in Pedagogical Approaches 5 Times a Week or More (Scale 0-100%)



Teachers reported a deeper understanding of pedagogical approaches that engage students. Most teachers mentioned the 7-E Model that was introduced and modeled in the science content courses (Burton & Campbell, 1997). Others emphasized the benefits of focusing on students' misconceptions. Quotes from a range of different teachers, which illustrate the range of pedagogical approaches participants learned from the project are presented below.

Through observations evaluators also found evidence that teachers were employing pedagogical approaches that had been employed in the content courses. In one Middle School classroom, the teacher began a new unit by asking students to present their prior knowledge on the topic. Each student wrote a fact on a sticky note and presented it to the class. The teacher informed the students that these notes could be revisited. For example, students might learn that they were incorrect or they may wish to replace a fact with more details. The teacher reported that by engaging the students with what they already know, the students enter the new unit feeling that they already have some knowledge and the teacher can respond to the level of his or her students, noting misconceptions or particular areas of strength.

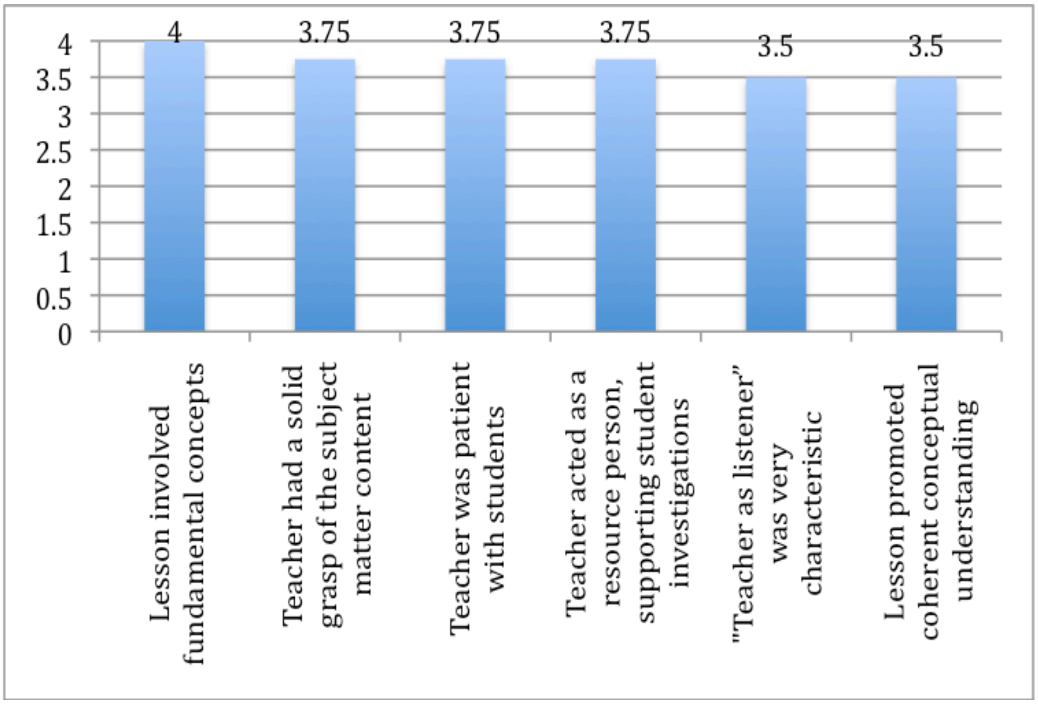
At another observation, an evaluator noted the language and introductory activities the teacher used with her students. Instead of beginning with definitions and a lecture on density, she had the students play with different blocks at the beginning of class. She then asked, "*through personal experience* we just had, what did you experience with the blocks?" After students shared responses, she then related the topic of density to another personal, real world example by asking students to picture themselves packing a suitcase. What happens when you try to fit a lot of stuff into a small space? How would you use the word density to describe what happens? Approaching a new topic through personal experience engaged the students and had them formulating their own hypotheses within minutes.

Participating teachers have reported specific changes they plan to make in their teaching in the upcoming year building upon their professional development experiences. A range of different teachers' reports illustrating the changes participants plan to make are presented below.

> To help prepare my students for the MCAS, I would give them many hands on opportunities to explore these various concepts. For instance, when learning about magnetism, I would let my students explore with magnets. Then once they had some time to explore with them, we would discuss what we had found. [4th grade teacher]
>
> To help students discover that sound travels through vibration, there are a variety of activities that can be done. 1) Sitting in an upright position, they can tap desktop & listen to tapping sound. Then with ear to table, they can tap again and note how the sound changes. 2) They can tap a tuning fork and hold it close to ear to hear sound. They can tap it again and gently touch it to a file cabinet to enhance vibrations. 3) They can tie both ends of a long string around the long side of a metal clothes hanger. Then hold the string against each ear as they bend over and let the hook end of hanger tap against a desk or table. All of these activities allow students to experience vibration and sound. [5th grade teacher]
>
> Some students may not have experienced an electromagnet lab so understanding the effects of having an electric current passing through a wire causing a magnetic field has to be explored. In the spirit of our recent classes, I would elicit from the eighth graders prior knowledge of wires connected to batteries such as in a flashlight. Showing a picture of a shipyard crane loading scrap metal onto a ship is worthy for this discussion. Once that happens, I would have a setup of lab materials that would encourage the construct of electromagnets or solenoids. Using a compass needle as a magnet field detector would be an observable data point for the electromagnet functioning. [8th grade teacher]
>
> I loved learning about how to become a better science teacher through the use of technology. The on-line workshops were time consuming, but I learned a lot from them. I know my students would do the same and it provides a great way to differentiate the learning because students can learn using different strategies and at their own pace. [10th grade teacher]

Observations of a sample of four teachers using the Reformed Teaching Observation Protocol (RTOP) provided evidence that among the small sample, teachers who participated in the project did demonstrate inquiry-based teaching on some of the RTOP items. Graphic 7 below presents the average scores on RTOP items that are specific to inquiry-based teaching associated with the content taught in the courses. The evaluation team will collect RTOP data during year 2 to examine changes over the course of the project. See Appendix for RTOP results on all items.

Graphic 7. Average Selected RTOP Scores from Sample of Teachers, Scale 0-4 (n=4)



The graphic above illustrates that the sample of teachers who were observed taught lessons that addressed fundamental concepts and that teachers demonstrated a solid grasp of the subject. Teachers supported student learning by acting as a resource person and listening to students' questions to guide their inquiry.

B. Discussion

Teachers who participated in Year 1 activities reported substantial changes in classroom practice and a small sample of observations revealed evidence of inquiry based practices and hands on labs. The reported changes in practice are notable and the early evidence of inquiry-based student centered learning is promising. The evaluation team will continue to collect data from teachers who are implementing lessons in the upcoming months and will report this data in next year's report.

VII. Impact on Student Achievement

A. Methods. TRITEC hired an external evaluation team from EAS, Inc.

1. *Participants*. The majority of teachers are implementing lessons in the upcoming weeks and therefore the student achievement data will be reported in the Year 2 MSP report. This year's report includes data from 43 teachers who completed the Post Professional Development Surveys who provided reflections on their perceptions of the impact of the professional development on their students.

2. *Design*. The design for this year is a mixed methods design that relies on teacher reports and qualitative observations of classroom practice. Data are from participants in the Year 1 professional development activities who completed Post Professional Development Surveys and

observations of students in 4 classrooms. Future reports will include data from a matched comparison group of students.

Instruments/Protocols. The external evaluation team developed Pre and Post Professional Development Surveys, observations of students using a running record, and semi-structured interview protocols with questions about the impact of the project on content knowledge, teaching practice and students' outcomes to collect evaluation data. The Pre and Post Professional Development Surveys asked participants questions about their confidence teaching content, employing a range of pedagogical practices, and using technology. It also asked about practice. The Post Survey also asked a question about expectations of future impact on their students. To enhance reliability of the Survey the instrument used Likert Scale items. To enhance validity, the Survey used items from national surveys and from surveys used by other MSP projects.

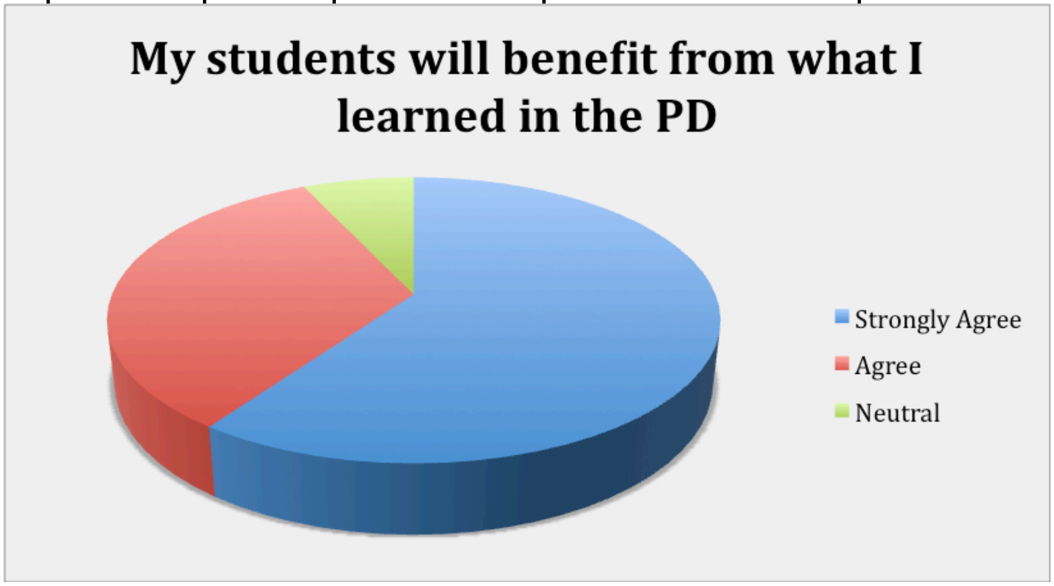
3. *Data Collection Procedures.* Survey data were collected using SurveyMonkey and observation data were collected using a running record.

B. Results

1. *Response Rate.* For the Year 1 report, data are from 43 teachers who completed Post Professional Development Surveys. This represents 100% of the teachers who participated in the professional development activities.

2. *Findings.* In Year 1, teachers reported that they believed their participation in the professional development would have an impact in the coming year. Graphic 8 below illustrates that over 90% of participants reported that they either strongly agreed or agreed that the professional development would have a positive impact on their students.

Graphic 8. Participants' Perspectives on the Impact of Professional Development on Their Students



Moreover, a number of teachers reported to the evaluators that they believed the professional development already had a positive impact on their students. One teacher reported:

> I recently tried the inquiry-based activity in my bio class- on a bio topic obviously- and found that it worked extremely well. Giving them many materials to work with and having them design something on their own with no instruction from me was very interesting. I thought they might be stuck at first for many want to just follow directions or steps given to them but that was in fact not the case. Many really thought out of the box and showed that they truly understood the concepts. I think that part of my lesson will hopefully work very well.

C. Discussion

Preliminary data reveal that teachers believe the professional development will have or has already had an impact on their students. Teachers who completed the project have developed lessons that utilize assessment items from previously published MCAS assessments. that are aligned with their lesson content. As teachers implement their lessons, the evaluation team will gather a sample of pre and post assessments and will perform secondary analysis to assess changes in student content knowledge after participating in the lesson. To date, the teachers have developed assessments with MCAS items that are associated with their lessons. The evaluation team is providing nominal stipends to a sample of teachers to administer pre- and post-assessments of their students. The evaluation team will gather the pre- and post-assessments after the teachers have implemented their lessons and will then provide the teachers with the stipend. The analysis of this data will be reported in subsequent years.

VIII. Impact of Supplemental Activities

A. Methods

1. *Participants.* All 43 teachers who participated in the project activities participated in the portion of the evaluation designed to assess the impact of the supplemental activities. The evaluators also analyzed the 32 matched Pre and Post Professional Development Surveys from

teachers (13 from Physics and 19 from Biology participants). In addition, observation data were collected from 4 teachers (1 Physics participants, 2 Biology participant, and 1 teacher who participated in both courses), 6 teachers were interviewed (2 Physics participants, 3 Biology participants, and 1 teacher who participated in both courses), and lessons (or portions of lessons) developed by 41 teachers were reviewed.

2. *Design*. The external evaluation team conducted a criteria-based evaluation (Wilson & Onwuegbuzie, 1999). As such, the evaluators analyzed the impact data against the desired benchmarks established by the Leadership Team.

3. *Instruments/Protocols.* The external evaluation team developed Pre and Post Professional Development Surveys, used existing valid and reliable measures including the Reformed Teaching Observation Protocol (RTOP), and developed interview protocols and document review protocols. The Pre and Post Professional Development Survey asked participants about attitudes, knowledge and practices regarding science teaching as well as curriculum/technology integration. The Post Professional Development Survey asked questions about confidence and current practice. It also asked a question about what participants planned to do in the future. In addition, the evaluation team performed secondary analysis of teacher assessment data that were collected by University of Massachusetts Boston faculty prior to and after completion of each course.

4. *Data Collection Procedures.* The evaluation team collected survey data using SurveyMonkey, reviewed teacher lessons posted to the project's Wiki spaces pages, and obtained a sample of lessons from teachers who volunteered to provide baseline lessons. Finally, document review protocols were used to analyze existing data.

Chart 3. Data Collection Activities

Data collection instrument/ Procedure	Description	Participants (Number)
Observations, informal interviews, and interviews	Informal teacher interviews Reformed Teaching Observation Protocol observations* Observation of call back	6 4 2 events (24 Biology participants and 18 Physics participants)
Surveys	Pre and Post Professional Development Surveys Matched comparison group Post surveys	32* 43
Document Review	Artifacts from professional development and from teachers including postings to the Wiki; final projects	Various

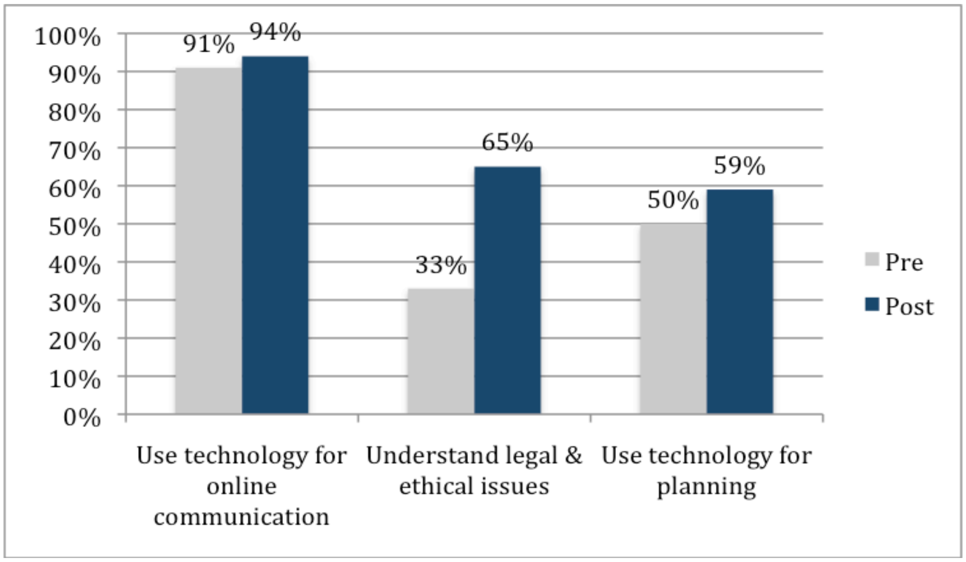
**The RTOP was used for observations of 4 teachers. The data were used for both the formative and summative evaluation and thus are listed in both tables.*

B. Results

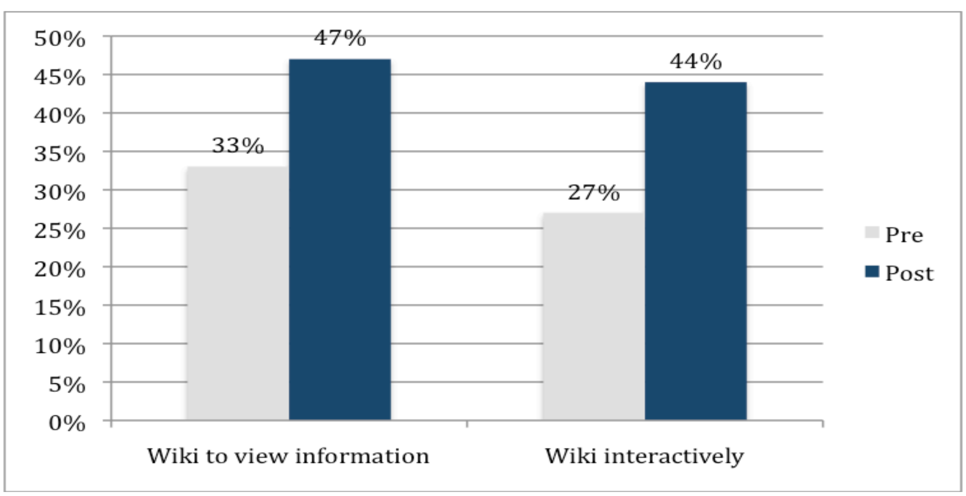
1. *Response Rate.* All of the participants (100%) completed Post-Professional Development Surveys. A sub-sample of 32 participants had also completed Pre Professional Development Surveys and had provided data to allow for matched comparisons.

2. *Findings.* Analyses of data reveal that participants reported that the supplementary activities had value and that a number of participants believed that the workshops were directly responsible for leading to improvements in their teaching. Graphic 9 below summarizes Pre and Post Professional Development Survey data.

Graphic 9. Participants' Pre and Post Professional Development Survey Results: Knowledge of Technology



Graphic 10. Participants' Pre and Post PD Survey Results: Knowledge and Use of Wikis



All of the teachers who completed the content coursework also completed some online workshops designed to support their development of science lessons that incorporate Web 2.0. All but two teachers completed the workshops and developed lessons. To date, a number of teachers have implemented their lessons and most plan to implement their lessons in the

upcoming year. Sample descriptions of lessons and teacher reflections on the content are presented below.

Sample elementary school lessons:

> This lesson is one of a series of lessons to be used to teach unit on forms of energy, light energy, & sound energy. It is created for 5th grade students & should take about a week to complete. By the time the students reach this lesson, they are finishing the study of sound and are at the end of the energy unit. Traditionally it is difficult for students to understand that frequency & amplitude are 2 different characteristics. The purpose of this lesson is to give them hands-on experiences to build a better understanding of amplitude. To view lesson, go to http://physics1.sciencecommunity.wikispaces.net/t_Marciano

Sample high school lesson:

> My lesson plan dealt with series circuits and the relationship between voltage, current and resistance in an electric circuit. My goal was to have students physically create simple series circuits and measure the voltage and currents at various points in the circuit. Data collected could then be analyzed to verify Ohm's law. The use of PhET electric circuit simulation was incorporated into the lesson so that students could collect more data at home. Using an online excel worksheet enabled the students to see the work of others and aid in discovering Ohm's law. The main objective was for students to develop qualitative and quantitative understandings of current, voltage, resistance, and their relationship (Ohm's law) in order to comply with state standards. (High School Teacher)

Graphic 11. Sample Lesson

Example Middle School Lesson Plan
State Standards: Structure and Function of Cells
Strand #2: Recognize that all organisms are composed of cells, and that many organisms are single-celled (unicellular) e.g. bacteria, yeast. In these single- celled organisms, one cell must carry out all of the basic functions of life.

Essential Question: What does it mean to be alive?
Lesson Question: What do plants and animals have in common?
Introduction: Introduce students to the idea that all living organisms are composed of one or more cells. And, to be considered living or having lived the organism must exhibit the following: growth, respiration, reproduction, feeding, excretion, sensitivity, movement**.**

Task:

1. Pos**t a** KWL chart and ask students what they know about animal and plant cells. Then what do they want to know**.**
2. Present different objects and ask students to determine if they are live or not. Have students explain their reasoning.
3. Introduce students to "alive" criteria - what is means to be alive or have been alive. i.e. growth, respiration, reproduction, feeding, excretion, sensitivity, movement**.**
4. Break students into groups of 4 based on varied levels of understanding and learning styles. Assign each group an animal or plant. (simple to complex)
    a. Each group will find a picture of the assigned plant/animal and a picture of a cell associated with that plant/animal.
    b. Each group will present their findings to the class and will discuss/present in terms of criteria for being alive and the complexity of the organism.
    (Can post presentations/pictures on classroom web page using web 2.0 tools)
5. Facilitate discussion in comparing and contrasting different organisms in terms of complexity and similarities. Refer to what all organisms have in common, what it means to be alive, and basic commonalities in cell functions in plants and animals. Make connection between what the "whole animal/plant" does and the "individual cell" of the animal/plant does.
6. Post what the students have learned on the KWL chart.

ACTIVITY TYPES:

- **Conceptual Knowledge Building Activity Types:** Students will view video on cells. They could view video on their own computers/hand-held devices or the video could be shown using a smart board to all students.
- **Procedural Knowledge Building Activity Types:** Students using the activities/labs mentioned above will observe and gather data which can be recorded on a spreadsheet, word processing software and or documented and shared with a flip video.
- **Knowledge of Expression Activity Type:** Using presentation software or a video creation students can demonstrate findings and discuss/debate understanding and concepts within the classroom or on a class website.

Lesson Experiences:
It is difficult for students to conceptualize the idea that all living organisms are composed of one or more cells. Also, that plant and animal cells have common functions/structures and that one cell must carry out all the basic functions of life.

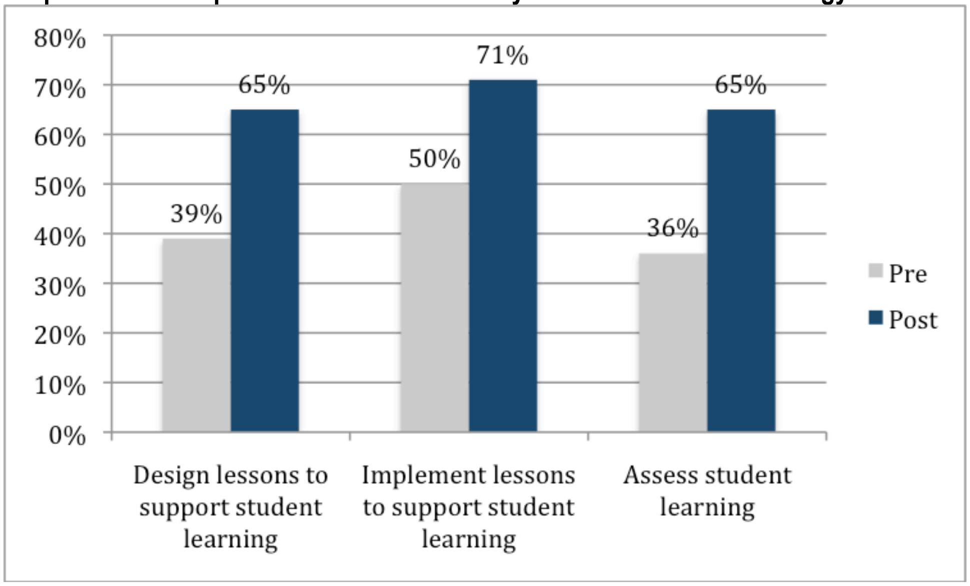
Conclusion:
As an introduction to cells- and the understanding that all living organisms are composed of one or more cells this lesson works well. It can be easily differentiated to all levels on ability.

Assessments:
Informal: Science journals, classroom discussions, KWL chart
Formal: Tests, quizzes, presentations

Resources:
Video to support understanding that all organisms are composed of cells.

http://www.teachersdomain.org/asset/tdc02_vid_singlecell/

Graphic 12. Participants' Pre and Post Survey Results: Use of Technology for Teaching



Teachers also reported a range of ways in which they were using technology for teaching and learning. For example, some teachers reported increased knowledge of Web 2.0. Different teachers described the Web 2.0 knowledge they gained. Illustrative quotes are presented below.

> I gained the ability to use technology in a way that I am comfortable and confident. (Anonymous)
>
> From the class I now have a greater understanding of how to develop a website and wiki activities I liked seeing the different Web 2.0 tools that are available to use in the classroom. My favorites were the Quizlet and Zoho Challenge sites that I learned about. (Middle school teacher)
>
> After exploring Web 2.0 tool ZOHO quiz maker, I am certain help is on the way for me to pretest and post test students and record data for driving my decisions for the individuals in class for reaching proficiencies of the science standards of the National System of Learners. ZOHO will assist me in correcting and evaluating the formative progress of individual learners. (Middle school teacher)
>
> The most useful part of the [professional development] for me was the summer workshop. It gave me the opportunity to create an on-line resource for my students. I look forward to seeing how they react to it. Will it be easy for them or overwhelming? Will they access it from home??? I was surprised how easy it was to create a wiki and do hope to be able to work more with the format. My hope is to create something on-line for each science unit that I teach so that my students can access it from home. It would be a resource to help them with homework & studying. Many of my students come from homes where parents want very much for them to succeed but for many reasons are unable to help them with homework or studying. Giving the students (and the parents) access to an on-line resource that directly correlates to something being taught in class might be very beneficial. (Fifth grade teacher)
>
> The process of science is not as simple or straightforward as past textbooks would lead you to believe or some science programs found on television for that matter. Web 2.0 resources can be used to promote a better understanding of the scientific process because of their very nature. Web 1.0 technologies have information available for use but do not change or is not interactive. It is like a scientist working alone without collaborating with others. The true process and advancement of science is in the sharing of ideas. Web 2.0 by its very nature is in constant flux and interactive. Ideas and data are easily shared with others as well as the testing evidence. The interactive nature of

> Web 2.0 allows problem solving from multiple points of view to take place quickly and efficiently. (High school teacher)

Participants also provided suggestions for future professional development workshops. Specifically, some suggested that it would be helpful to have the workshops available to begin prior to participating in the professional development science course, to have more hands on assistance, and to have additional one-on-one opportunities to use the technology. In addition, some suggested it would be helpful to have additional sample exemplars for future students. Sample suggestions from different teachers follow.

> I would like to have an instructional session so I can practice using a web tool, before trying to implement them into a lesson.
>
> It would be helpful to me and probably others, even though I cannot speak for them, to have an exemplar of the lesson plan done by someone who has done this workshop, say from the physics course. Having never done anything like this I know that I have no idea just what you are looking for. I guess I am actually playing the part of my students when I give them a project that they are unsure as to how to proceed, so I show them previous years work to give them insight as to what needs to be done.

C. Discussion

Overall, the participants viewed the supplemental activities quite favorably. The Leadership Team has reflected on the suggestions from participants and has made plans to incorporate changes in subsequent supplemental opportunities.

IX. Integration of Courses and Activities with District and School Initiatives

A. Methods

1. *Participants*. The Project Director, Teacher Learning Center Directors and the Leadership team participated in activities to support integration of the courses and activities with district and school initiatives.

2. *Design*. The data presented in this section are descriptive.

3. *Instruments/Protocols.* The evaluator used a running record to record data from ongoing project meetings.

4. *Data Collection Procedures.* This section was written by the Project Director and the evaluator verified the information by reviewing data collected during ongoing project meetings and reviewing project, district, and school documents.

B. Results

1. *Response Rate.* Not applicable since the data in this section are from a convenience sample.

2. Findings.

The school district science curriculum leaders participated in project meetings and district-based workshops. This ensured that the district and school needs were met, that the districts were aware of project activities, and that project components were integrated into school improvement initiatives and district-based professional development for teachers and administrators.

The district-based Teacher Learning Center Directors offered professional development in the partner districts. The project management team met bi-weekly to review project status and progression of the project workplan. A project Advisory Board including all key project partners met bi-annually to review the performance of project activities.

While the majority of secondary teachers of science, technology and mathematics in this partnership are licensed in the content they teach, K-6 elementary teachers who teach in self-contained classrooms (as well as English Language Learner and special education teachers) hold generalist licenses, and some grade 5 and 6 teachers hold math licenses. In several of the districts there are teachers who are licensed in one area of science but teaching in another.

This project was fully aligned to the major goals found in all of the partnering districts school improvement plans. The science curriculum and administrative leadership in the districts have tremendous interest and commitment in increasing the number of teachers in their districts who advance their content knowledge by participating in high-quality professional development that includes rigorous immersion in science course instruction and curricula, and that assists teachers in learning science through inquiry-based learning experiences so they can transfer these learning strategies to their classrooms.

The project-aligned goals in all the participating school districts include: improving MCAS performance to the proficient or advanced levels; continuously examining and improving work by teachers and administrators to evaluate success based on evidence of student progress; and ensuring that professional development in each school and district focuses on enhancing teaching and learning. Each district has goals that address the key elements of 21st century education, with an emphasis on core academic subjects with a deep understanding of content. As a core academic subject, science content is of great importance to all the districts and their leadership. All the participating districts and schools were actively involved in the planning of this science initiative, and indicated a similar need for this professional development. In addition, the inclusion of science MCAS as a graduation requirement for the public schools increased the immediate need for this professional development content focus.

Several of the partner districts are in the midst of changes in their science curriculum and/or science teaching structure. For example, one district recently changed to a *Physics First* curriculum where all students begin their high school science course of study with Physics. Another district recently changed to having K-8 school building math and science specialists, and another district is shifting towards upper elementary math and science specialists. Prior to this project, except in Malden there were no professional development programs in place to train teachers in these changing roles, and to ensure they have the science content expertise necessary to enact these teaching changes successfully.

The Teacher Learning Center Directors (TCLDs) attended leadership, curriculum and school-based meetings to introduce teachers and administrators to the project and the available lessons. In addition, the TLCDs have delivered in-district technology professional development and participated as members of district technology committees. The TLCDs will offer additional professional development in the partner districts on utilizing the newly created science lessons placed online upon completion of each year. This bank of available lessons will grow throughout the 3 years of project funding, as 50 teachers each year complete their inquiry-based lessons and the TLCDs convert these lessons into an online format and place them on the TRITEC server for easy access to all districts.

SELECTED BIBLIOGRAPHY

Burton, V., & Campbell M. (1997). The seven "E" teaching model. *Science Scope, V21, n2*, pp 32-34.

Fishman, J. J., Marx, R. W., Best, S., & Tal, R. T. (2003). Linking teacher and student learning to improve professional development in systemic reform. *Teaching and Teacher Education, 19,* pp 643-658.

Miles, M. & Huberman, A. (1994). *An expanded sourcebook: Qualitative data analysis* (2nd ed.). Thousand Oaks, CA: Sage Publications.

Piburn, M., Sawada, D., Falconer, K., Turley, J. Benford, R., Bloom, I. (2000). Reform Teaching Observation Protocol (RTOP).

Wilson, V. & Onwuegbuzie, A. (1999). *Improving achievement and student satisfaction through criteria-based evaluation: Checklists and rubrics in educational research courses.* Paper presented at the Annual Meeting of the Mid-South Educational Research Association (Point Clear, AL, November 17-19, 1999). Retrieved from the world wide web October 29, 2009: http://www.eric.ed.gov:80/ERICDocs/data/ericdocs2sql/content_storage_01/0000019b/80/15/fa/e3.pdf